

Electronic Supplementary Information

Ce_{0.80}M_{0.12}Sn_{0.08}O_{2-δ} (M = Hf, Zr, Pr, and La) ternary oxide solid solutions with superior properties for CO oxidation

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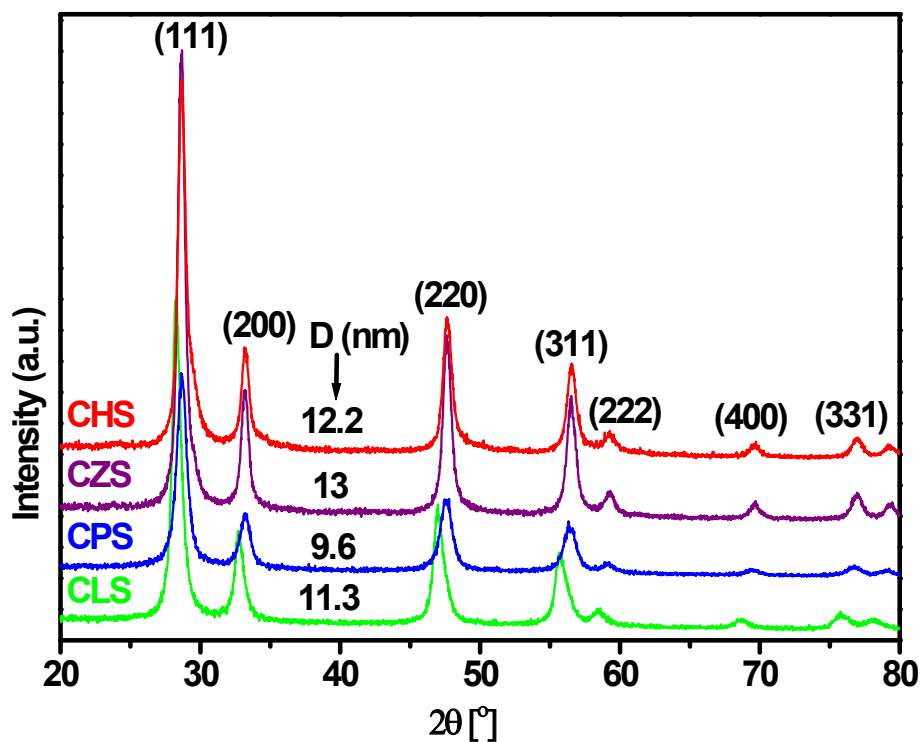
Table S1. Desired quantities of metal precursors for the preparation of co-doped CeO₂ samples (8 g batch).

Precursors	CHS	CZS	CPS	CLS
Ce(NO ₃) ₃ ·6H ₂ O	15.878 g	16.887 g	14.677 g	14.715 g
SnCl ₄ ·5H ₂ O	1.281 g	1.363 g	1.184 g	1.186 g
HfCl ₄	1.756 g	–	–	–
ZrO(NO ₃) ₂ ·xH ₂ O	–	1.347 g	–	–
Pr(NO ₃) ₃ ·6H ₂ O	–	–	2.205 g	–
La(NO ₃) ₃ ·6H ₂ O	–	–	–	4.401 g

Table S2. TEM-EDX analysis of co-doped CeO₂ samples.

Sample	Element	Atomic (%)
Ce _{0.80} Hf _{0.12} Sn _{0.08} O _{2-δ}	Ce	80.5
	Hf	11.5
	Sn	7.9
Ce _{0.80} Zr _{0.12} Sn _{0.08} O _{2-δ}	Ce	80.8
	Zr	11.7
	Sn	7.4
Ce _{0.80} Pr _{0.12} Sn _{0.08} O _{2-δ}	Ce	79.7
	Pr	11.9
	Sn	8.3
Ce _{0.80} La _{0.12} Sn _{0.08} O _{2-δ}	Ce	79.9
	La	12.2
	Sn	7.8

Figure S1. X-ray diffraction patterns of spent co-doped CeO₂ samples.



The XRD patterns of all spent catalysts along with their crystallite sizes are presented in Figure S1. From this, it is evident that the crystallite size of spent CZS, CHS, and CLS samples considerably increased compared to their corresponding fresh catalysts. However, the crystallite size of spent CPS is similar to that of fresh CPS sample. This result obviously indicates the better stability of CPS sample than other investigated ternary oxide samples.

Figure S2. XP spectra of Hf 4f for CHS sample, Zr 3d for CZS sample, Pr 3d for CPS sample, and La 3d for CLS sample.

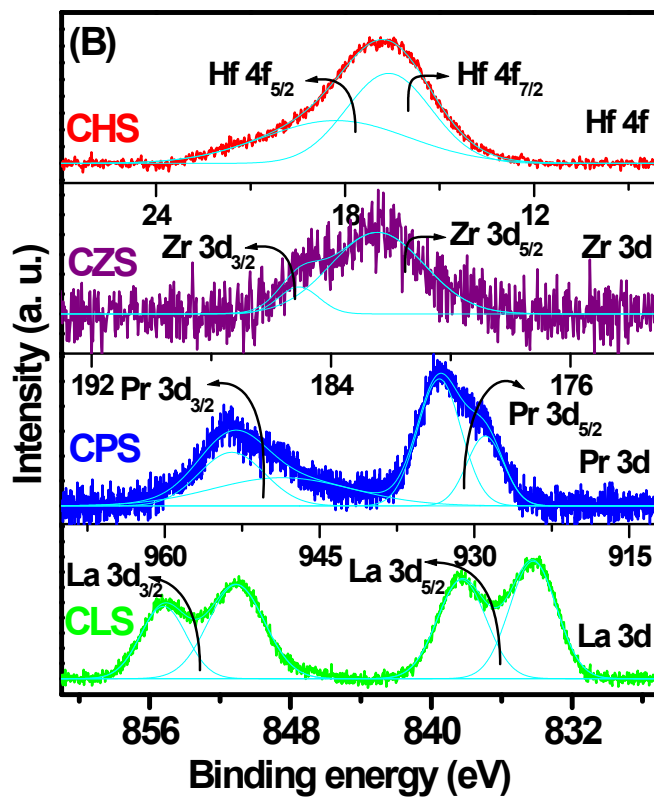


Figure S3. Catalytic activity of $\text{Ce}_{0.80}\text{Zr}_{0.16}\text{Sn}_{0.04}\text{O}_{2-\delta}$ (CZS4), $\text{Ce}_{0.80}\text{Zr}_{0.12}\text{Sn}_{0.08}\text{O}_{2-\delta}$ (CZS8), $\text{Ce}_{0.80}\text{Zr}_{0.08}\text{Sn}_{0.12}\text{O}_{2-\delta}$ (CZS12), and $\text{Ce}_{0.80}\text{Zr}_{0.04}\text{Sn}_{0.16}\text{O}_{2-\delta}$ (CZS16) samples for CO oxidation.

